South Dakota Space Grant Consortium
South Dakota School of Mines & Technology
Edward F. Duke, Ph.D.
(605) 394-1975
http://sdspacegrant.sdsmt.edu
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PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The South Dakota Space Grant Consortium is a Capability Enhancement Consortium funded at a level of $430,000 for fiscal year 2013.

PROGRAM GOALS

Consortium Management: To ensure quality and fairness in all Consortium programs and alignment with the needs of NASA, the affiliate organizations, and the state of South Dakota.

Fellowship/Scholarship: To administer a fellowship/scholarship program that offers educational and research opportunities to students from diverse backgrounds who are pursuing degrees in fields of science, technology, engineering, and mathematics (STEM) that align with NASA's mission and those of SDSGC affiliates.

Research Infrastructure: To promote the improvement of research programs and capabilities of Consortium affiliates with an emphasis on the fields of aerospace, earth science, and supporting STEM disciplines.

Higher Education: To build interdisciplinary programs related to NASA's Education Outcome 1 at the state's institutions of higher education and to support related programs that serve to strengthen STEM education in South Dakota.

Diversity of Participants: To model diversity in all Consortium programs and activities, with an emphasis on Native Americans, which make up the state's largest minority group.

Workforce Development: To use the Consortium's statewide network of scientists, engineers, and educators to provide talented students with a pathway to careers that will contribute to a highly-trained and diverse workforce for NASA and expand the nation's research and development capacity.

Longitudinal Tracking: To acquire and maintain accurate longitudinal data on all students and faculty who have received significant support from SDSGC in order to assess the impact of the support on their education, career, and professional development.
Minority-Serving Institutions: To ensure that Minority-Serving Institutions in South Dakota, which are exclusively Tribal Colleges and Universities, are represented in the planning and implementation of all Consortium programs.
Precollege: To increase student and teacher awareness and access to education and career opportunities in aerospace, earth science, and supporting STEM disciplines.
Public Service: To enhance public scientific literacy in aerospace and earth science, to complement community efforts in STEM education, and to inspire citizens of diverse backgrounds through the excitement of scientific exploration and discovery.

PROGRAM/PROJECT BENEFIT TO OUTCOME (1, 2, & 3)

The following highlight reflects the impact of SDSGC programs in support of NASA Education Outcome 1: *"Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals."*

Among the myriad of NASA-related STEM programs supported by Space Grant is the support provided to South Dakota School of Mines and Technology's (SDSM&T's) chapter of **Students for the Exploration and Development of Space (SEDS.)** The following two individuals are excellent examples of students graduating in disciplines that are directly related to NASA workforce development goals. **Carly Sandin**, a Mechanical Engineering senior at SDSM&T graduating in May 2014 has served as President and Vice President of SDSM&T's chapter of SEDS and she has remained a leader of the university's Lunabotics *Moonrockers* Team that competes at NASA KSC. Carly conducted a summer 2013 internship at Boeing under combined support of Space Grant and Boeing, and a summer 2012 internship at NASA Johnson Space Center fully funded by Space Grant. She wrote the following to SDSGC regarding her internship during FY2013: *"Space Grant support increased my activities in the aerospace field allowing me to further emphasize my mechanical engineering degree through space related internships, conferences, and travel to NASA competitions. I also have more of an understanding of the field and more of a desire to continue into a space-related career."* She went on to say: *"I have worked on increasing flight deck technology at NASA and worked on the core stage of the SLS (Space Launch System) through Boeing."* The current faculty advisor of SDSM&T's A) SEDS chapter, B) *Moonrockers* Lunabotics Team, and C) Autonomous Underwater Vehicle Team is **Dr. Jason Ash**. Dr. Ash is a 2013 PhD graduate from SDSM&T in Mechanical Engineering and he was a Space Grant student fellow for several years prior to graduation. In replying to SDSGC's FY2013 Longitudinal Tracking survey, he wrote: *"The SDSGC graduate fellowship helped provide support for the final year of my doctoral studies including funding to participate in the ASME International Mechanical Engineering Congress and Exposition. Here, a peer-reviewed paper was accepted for the Advances in Aerospace Technology track with the conference presentation occurring in November 2013 in San Diego, CA. The fellowship provided support for the conference registration and travel. This had a significant impact for my family and I who were struggling to keep up with both life and academic expenses. It was also rewarding to earn the recognition of being awarded a SDSGC graduate fellowship. My future plans are to continue teaching at the university*

with a research emphasis in aerospace structures and materials while advising aerospace related projects to assist interested students into this career path."

The following highlight reflects the impact of SDSGC programs in support of NASA Education Outcome 2: *"Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty."*

22nd Annual Aerospace Career and Education (ACE) Camp 2013 – Hosted at affiliate South Dakota State University (SDSU) every July, this four-day residential camp provides high school-aged students the opportunity to get an early start on aviation and aerospace careers. ACE Camp 2013 participants got to fly a Cessna 172 aircraft, spend two hours in the flight simulation lab, participate in NASA lessons taught by educators who attended NASA Summer of Innovation programming, build and launch a model rocket, and participate in other aerospace activities. ACE Camp enables students to make informed decisions as they consider college and career options. Having completed the program, students are more knowledgeable about the importance and diversity of aviation and aerospace careers. A 17-page evaluation report of ACE Camp 2013 was prepared by SDSGC's evaluator at SDSU. Evaluation in all of SDSGC's events, including ACE Camp, is intended to document, measure, and assess the impact of such programs on the target group. This is accomplished by developing and administering surveys of participants' knowledge and attitudes about the Consortium, NASA, and STEM careers. Results of the survey are then used by the Consortium to make adjustments by strengthening the activities that are working and dropping or improving the activities that are not having the intended impact (SDSGC Strategic Plan strategy D.1.7.1). ACE Camp 2013, was held on July 14-17th, 2013, and hosted 23 high school students. Since ACE Camp's inception in 1992, 454 students have completed the program, averaging 21 students per year. The percentage of female and minority students are tracked each year and are compared to SDSGC's targets of at least 40% female and 10% minority student participation. With those targets falling short in 2013, SDSGC management identified the need to increase recruitment of students from those target groups next year and beyond.

The following highlight reflects the impact of SDSGC programs in support of NASA Education Outcome 3: *"Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission."*

Sanford Underground Research Facility (SURF) Public Outreach – The public outreach program of SDSGC's affiliate SURF brought underground science to audiences in several towns across South Dakota during June and July 2013. More than 5,000 members of the general public were reached. On June 8, 2013, the *"It's All About Science Festival"* was held at the Sanford Research Center in Sioux Falls, SD. The science festival promoted STEM education and careers among more than 4,000 members of the general public. The event included a videoconference between the festival location in Sioux Falls, SD, and two scientists in the Davis Campus on the 4,850 level of the underground lab in Lead, SD. Dark matter physicist Richard Ott of the Large Underground Xenon (LUX) experiment and Sanford Lab physicist Mark Hanhardt, a former SD Space Grant fellow, gave a presentation and then took questions from the audience. On June 10, 2013, the program was repeated in Yankton, SD, and again on

June 20th in Mitchell, SD. Then on July 13, 2013, SURF hosted the sixth annual *"Neutrino Day"* in Lead, SD, for over 1,100 people. Speakers and experts from SURF and from the local community included engineers, administrators, interns, artists, retirees, students, project managers, emergency responders, hoist operators, multimedia specialists, technicians, scientists, and researchers in the fields of dark matter detection, neutrinoless double-beta decay, and biofuels.

Although the following metrics are not counted in SDSGC's precollege participant numbers in order to avoid duplication, the following is an excellent example of a strategic partnership with an informal educational affiliate. During the 2013-2014 school year to date (and under SDSGC affiliate The Journey Museum's 2010 three-year "Competitive Program for Science Museums and Planetariums" (CP4SMP) grant for ~$492,000), NASA STEM programming was provided via the museum's portable "ExploraDome" Uniview Planetarium to 17 Tribal, public, and private schools throughout the state. The program has reached 2,573 students and 146 teachers and adults as direct participants. Of the 2,573 students, 1,749 were elementary, 712 middle school, 104 high school level, and 8 were not reported. Of the 1,158 students reporting their ethnicity, 70.7% were White, 7.1% were Native American, 1.6% were Black, 1.6% were Asian, 1.6% were Hispanic, 2.8% were Other and 14.7% were more than one race.

PROGRAM ACCOMPLISHMENTS

The performance *Goals* for Fellowship, Research Infrastructure, Higher Education, Precollege, and Informal Education are listed above under "Program Goals." The specific *Performance Objectives* from Table G.3 "Summarized Table of Consortium Goals and SMART Objectives" and from the Consortium's Strategic Plan included in SDSGC's FY2010 Program Plan that are applicable to the accomplishments listed below are given in *italics* at the start of each accomplishment.

NASA Education Outcome 1 Accomplishments

Fellowships/Scholarship

Annual Performance Objective: Statewide competition offered at all 10 higher education affiliates including three Tribal Colleges; emphasis on internships with NASA, aerospace industry, DUSEL, and EROS**. [At least 55 awards ($1,000-$12,000); all awardees enter longitudinal tracking system; at least 10% minority and 40% female; at least three NASA interns and five EROS interns]*

* DUSEL – Deep Underground Science & Engineering Laboratory, now referred to as Sanford Underground Research Facility (SURF)

** EROS – USGS Earth Resources Observation and Science Center

Fifty-eight (58) applications were received from students from six of the Consortium's universities in competition for funds provided under SDSGC's FY2013 Fellowship/Scholarship Stipend Program. The FY2013 "base award" budgeted $110,000 in NASA funding for fellowship/scholarship funds. SDSGC's Management Team reviewed the applications in May 2013 and made selections. Awards were provided to 38 students from six universities. Ten awardees were graduate level (26%) and 28 undergraduate (74%). The Consortium more than doubled its goal of 10% of awards to minority students in that 10 of the 38 funded students (26%) are minority students, and all

10 of them are Native American. A fraction under 40% (39.5%) of the total number of awards, and 45% of the total dollar amount of awards, were provided to female students, which essentially met or exceeded the targeted goal of 40% of awards to females. Two of five students who conducted FY2013 internships at NASA Centers were directly-funded by Space Grant; the other three were funded by their NASA Centers.

Research Infrastructure

Annual Performance Objective − (Research support) Support new and developing research, especially multidisciplinary and collaborative projects, in fields aligned with NASA's mission. [At least two SDSGC fellowships or scholarships are awarded each year for students to work on NASA EPSCoR or other NASA-related research projects.]
Considerable progress was again made during FY2013 on the Sanford Underground Research Facility (SURF), an affiliate of SDSGC. Closed in 2000 after 124 years of operation, the Homestake gold mine was selected by NSF and later funded by DOE for development as an underground laboratory that serves to shield sensitive, cutting-edge physics research experiments from background cosmic radiation. The project is the most ambitious research infrastructure project in South Dakota's history. In recent years, SDSGC has played an active role in funding students and research projects at the site.

FY2013 Dark Matter Research Findings at SURF – In February 2014, it was announced that a new calibration of the Large Underground Xenon (LUX) dark matter detector brought a ten-fold increase in calibration accuracy, confirming findings announced in October 2013 from the instrument's first 90-day run. If low-mass, subatomic, dark matter particles known as Weakly Interacting Massive Particles (WIMPs) had passed through the detector, the LUX experiment would have found them. Dark matter is thought to account for about 80% of the mass of the universe, and without its gravitational influence, galaxies would fly apart into the vastness of space. Though it has not yet been detected directly, the existence of dark matter is a near certainty among physicists. A new calibration of the LUX dark matter detector in 2013 demonstrated the experiment's sensitivity to ultra-low energy events. The detector proved to be extremely sensitive, but found no evidence of dark matter during its first run, ruling out a wide range of possible models for dark matter particles. LUX will expand its search during 2014 when it begins a second, year-long search for dark matter at an even greater sensitivity.

Davis-Bahcall Scholarships at SURF - Two of the nine Davis-Bahcall college freshmen selected for the summer 2013 program were funded directly by SDSGC, each with a stipend of $4,000 from Space Grant that went to Rashyll Leonard, Physics major at SDSM&T, and Eric Roach, Physics major at University of South Dakota (USD). The four-week summer program, now in its sixth year, includes study at SURF and at Italy's Gran Sasso National Laboratory, the world's largest underground lab. Students also visited Fermi National Accelerator Laboratory and Argonne National Laboratory. The Davis-Bahcall program provides opportunities for high school seniors and college freshmen to meet and study with scientists and engineers engaged in world-class research. The program is funded by support from 3M and SDSGC. During the application phase, 65 students applied for the summer 2013 program. Scholars were selected based

on grades, extracurricular activities, application essays, support letters, personal interviews and interest in STEM careers. The 2013 Davis-Bahcall Scholars studied physics, engineering and geology, and they received college credit for participation in the program.

Annual Performance Objective − Increase the participation of women and underrepresented groups in statewide research programs and facilitate their subsequent entry into STEM careers. [SDSGC fellowship/scholarship funds for research or design experiences at SDSGC academic institutions, EROS, and NASA Centers will equal or exceed 10% to minorities and 40% to females.]
Space Grant fellow Camille Griffith, a Native American senior majoring in Natural Science at Tribal College affiliate Oglala Lakota College was one of only 13 students statewide selected to present her Space Grant-funded research at the 2014 Student Research Poster Session at the State Capitol Rotunda on March 6, 2014. Camille was provided a research stipend from Space Grant during FY2013 for her project titled: *"Home Range and Habitat Compatibility of Ornate Box Turtles (Terrapene ornata) in South Dakota."* Camille has been a Space Grant fellow for the past three years and has been supported with $8,500 in Space Grant funding. From an early age, she had a passion for environmental protection and community involvement. In her current undergraduate work, she is researching the genetics and movement patterns of the Ornate Box Turtle on the Pine Ridge Indian Reservation. As a proud Oglala Sioux tribal member she plans to continue her education in graduate school and further her research projects on the Pine Ridge Reservation. She hopes to make her mark in the field of ecology and initiate more cultural methods in conducting environmental research.

Annual Performance Objective − Support collaborative research proposals in NASA areas. [At least one collaborative proposal submitted]
SDSGC working in concert with SD NASA EPSCoR submitted one major research grant proposal under the 2013 NASA EPSCoR CAN. The proposal, a collaboration between SDSU, SDSM&T, NASA JPL, and NASA ARC, was titled: *"Utilizing Remote Sensing-based Energy Balance Estimates for Soil Moisture Determination and Life Cycle Analysis to Measure the Sustainable Performance of Agricultural Production."* It was not selected by NASA for funding.

Higher Education
Annual Performance Objective − Statewide competition for Program Initiation Grants for course development offered at all 10 higher education affiliates including three Tribal Colleges; emphasis on interdisciplinary research focused on NASA, DUSEL, or EROS priorities. [At least two awards ($5,000-$20,000)]
During FY2013, SDSGC selected and funded two competitive Project Innovation Grants (PIG grants) in the areas of Higher Education and Precollege. Although the two selected projects were funded with the previous year's Space Grant, the projects were awarded too late to report in SDSGC's 2012 APD report. Because of that, and due to the work being done during FY2013, the projects are reported here. Seven proposals were received under the competitive announcement and the following two were selected for funding. The first was a joint proposal by consortium affiliates SDSU and Augustana College titled

"Looking Beyond One's Self Toward Stars and Visions" funded in the amount of $32,000 in NASA funds, to be matched 1:1 with non-federal cost sharing by the affiliates. During the 2013-14 academic year, two college courses (Mathematics and Astronomy) were provided to 10 American Indian high school seniors attending Sioux Falls Public Schools. Program participants were paired with designated American Indian college student mentors, and they met weekly. American Indian faculty and students from Augustana College and SDSU, together with student affairs staff, guided the seniors through the steps necessary to transition from high school to college. The project involved: A) academic preparation through the completion of college-level mathematics and astronomy courses, and B) training on the social, economic, cultural, and spiritual preparation necessary for success in higher education. The second project selected for funding in the amount of $20,000 was an SDSM&T project titled *"Basic Small-Scale Submarine for Educational and Outreach Activities."* The project allowed three undergraduate students to design and build a prototype of a basic small-scale submarine that can be easily used in both university-level course related learning activities and in precollege outreach. Educational plans were prepared for various grade levels of students.

The FY2013 PIG grant competitive solicitation was announced in January 2014 and open to proposals from all SDSGC affiliates in the program areas of Higher Education and Precollege. Because SDSGC was forward-funded with its FY2014 base award in September 2013, the consortium Management Team decided to combine the FY13-14 budgeted PIG funds and make over $56,000 available under the competitive solicitation. Thirteen (13) proposals were received and in March 2014, the following six (6) meritorious project were selected for funding in the total amount of $56,567. Because these projects were selected just two weeks prior to this APD report deadline, the projects will be described in next year's (FY2014) APD report.

- Journey Museum – *Summer in Space* ($13,000)
- SDSM&T – *Green Chemistry Education Workshop for Middle School Teachers in the Rapid City Area* ($12,000)
- DSU – *The STEM Institute: An interdisciplinary program for maximizing student recruitment and retention in STEM majors at DSU* ($10,000)
- USD – *SD Planetary Exploration Education Center* ($9,727)
- Augustana College – *Sonia Kovalevsky Day* ($6,840)
- SDSM&T – *Mines Experimental Rocketry* ($5,000)

Annual Performance Objective − Support interdisciplinary student engineering design teams in NASA priority areas. [At least three engineering design teams]
SDSGC supported **five multi-disciplinary university student teams during FY2013** that participate at national competitions. These teams included SDSM&T's new Hybrid Sounding Rocket Team, Robotics Team, *Moonrockers* Lunabotics lunar regolith excavator team, Unmanned Aerial Vehicle Team, and Autonomous Underwater Vehicle Team. All of the SDSGC-supported teams have outreach programs to precollege students. One team's example is described below.
New University-level Sounding Rocket Team in South Dakota - The "SDSM&T Mines Experimental Rocketry Team" formed in the fall of 2013 and is developing a hybrid sounding rocket for the 9th Intercollegiate Rocket Engineering Competition

(IREC) that will be held June 26-28, 2014, in Green River, UT. This is the first university-level student rocket team in South Dakota's history. The hybrid rocket project provides another opportunity for student-led, space-related activities at SDSM&T. The 13-member multidisciplinary team consists of students in Mechanical Engineering, Electrical Engineering, and Chemical Engineering, and three faculty advisors. With a large number of students involved in aerospace related programs and teams at SDSM&T such as the Aero Design and *Moonrockers* teams associated with the campus chapter of Students for the Exploration and Development of Space (SEDS), the addition of the SDSM&T Mines Experimental Rocketry Team helps attract additional interest and support from external aerospace organizations. This should result in a stronger relationship between SDSM&T and the aerospace community. The objective of the IREC competition is to launch and recover a rocket with a 10-pound scientific payload and reach as close to the target altitude as possible. The SDSM&T team registered for the advanced category, which has a target altitude of 25,000 ft. above ground level. The SDSM&T team is designing and building the entire 13-foot long, 9-inch diameter rocket and engine from scratch. The Black Hills Business Development Center located on the campus of SDSM&T donated 1,600 square foot of laboratory space to the rocket team, valued at $15,000. SDSGC provided $6,000 in FY2013 Space Grant funding in support of the team's total first-year budget of $14,600. With 38% of the team membership consisting of underclassmen, and the annual IREC competition in Utah, SDSGC's management envisions the new sounding rocket team to become a continuous multidisciplinary team on campus. The team's primary faculty advisor, Dr. Jason Ash, was a Space Grant fellow while he was a PhD student at SDSM&T.

Annual Performance Objective − Enhance faculty and undergraduate/graduate student development through planning visits, internships, and fellowships at NASA Centers and EROS.

As an additional Higher Education accomplishment and expanding SDSGC's support of student internships and visits to NASA Centers during FY2013, SDSGC provided similar experiences within aerospace industry. In the absence of any state aerospace industries, SDSGC established a major partnership with L-3 Communications West (Salt Lake City) in 2011. During FY2013, this partnership included: A) two SDSM&T student summer 2013 internships (for Jerry Farke and Terry Nguyen) fully-funded by L-3 for a total of $24,098 in L-3 matching funds, B) one $5,000 Space Grant stipend for an SDSM&T student in the Math and Computer Science Department (Rachel Krohn), and C) one $5,000 stipend for an SDSM&T student in the Industrial Engineering and Engineering Management Department (Laura Case). Similarly, SDSGC supported student development by helping to fund the participation of seven student members of SDSM&T's chapter of Students for the Exploration and Development of Space (SEDS) in the SEDS *SpaceVision* conference held in Phoenix, AZ, on Nov. 7, 2013.

NASA Education Outcome 2 Accomplishments

Precollege

Annual Performance Objective − Support statewide precollege robotics programs, including resources, teacher training workshops, and state competition. [At least 30 teams participate in SD FLL robotics state competition (400 students)]

SDSGC began promoting and supporting precollege robotics teams in 2003. The following accomplishments reflect the positive impact of those investments:
Ten (10) applications were received for the 2014 (FY2013) annual **Daniel Swets Robotics Materials Award**, the highest number of robotics proposals since SDSGC began supporting robotics. The 2014 winners of a combined total of $10,150 in Space Grant-funded robotics supplies included: A) Stephanie Chambliss of the 4H SDSU Extension program in Charles Mix Co. for her after-school and in-school robotics programs at four local schools, B) James Kruse of Wessington Springs Middle School for his 7th and 8th grade robotics STEM activities, and C) Brenda Waterbury of Brandon Valley School District for her 5th grade class *"Mission to Mars"* robotics challenge. The awards were presented on Feb. 7, 2014, at the joint conference of the South Dakota science and math teachers' associations in Huron, SD.

Forty (40) middle school teams competed in the **5th Annual South Dakota FIRST LEGO® League (FLL) Robotics Championship Tournament** held at SDSGC's affiliate Augustana College in Sioux Falls, SD, on January 18, 2014, with $10,000 in support from SDSGC. Among 84 SD FLL middle school teams across the state during FY2013, 42 teams qualified at their respective regional competitions to advance to the state finals (and 40 teams competed there,) at which a total of 350 students participated. Four FIRST Robotics teams from South Dakota (two FLL middle school teams and two FIRST TECH Challenge "FTC" high school teams) earned the right to participate in post-season competitions, for which SDSGC provided $500/team to assist with travel. The "Dark Knights" team from Sioux Falls won the SD FLL State Tournament and will travel to the first-ever Canadian International Open FLL Championship in Toronto, Canada, in April 2014, where they will compete against 71 other teams (one-third from Canada, one-third from the U.S., and one-third from outside North America.) The "Caffeinated Bacon Bots" of Sioux Falls won 2nd place at the SD FLL State Tournament and earned the right to compete in the North American Open Championship at LegoLand in Carlsbad, CA, in May 2014. The number of students involved with the FLL activities in South Dakota has grown from 140 students in the 2008/09 season to just over 600 who participated in one of four SD FLL regional competitions during the 2013/2014 season.

FIRST TECH Challenge (FTC) Team Performance in FY2013 – Two FTC high-school-level robotics teams from Pierre and Sioux Falls, SD (whose members competed in SD FLL when they were in middle school) formed in 2012. Both teams competed in FTC regional competition during FY2013 and both earned bids to continue on to Super Regional Competitions. FTC Team 5250 named "Loading" from Pierre won the top award at the Wyoming state competition and a bid to the Western Super Regional in Sacramento, CA, on March 20-22, 2014. FTC Team 7123 named "The Fellowship of the Loose Screws" from Sioux Falls won the Motivate Award at the Iowa State Competition, which earned them a bid to the North Super Regional in Iowa City, IA, on April 3-5, 2014. Both of these high school teams conducted extensive educational outreach, mentoring, and even coaching to younger (SD FLL middle school) teams. This included teaching LEGO robotics and engineering classes and providing FTC demos at SD FLL competitions and at local STEM events. They also spoke and provided demos at the SD state legislature and at several of the Women in Science Conferences in South Dakota. In

February 2014, a female student from the FTC Team "Loading" wrote the following to SDSGC: *"… This [winning the right to compete in the Super Regional Competition in Sacramento, CA, in March 2014] is a huge accomplishment for our team and a great opportunity for us to experience the next level of innovation and strategy in this competition. … The first thing that the FTC program does is develop your critical thinking skills. It challenges you to think outside the box to come up with new, innovative solutions. You sometimes find yourself thinking of an idea that in no possible way could ever work, but you still share it with your teammates and then, in no time at all, it becomes a reality. This, in itself, encourages the flow of ideas and makes us all better problem solvers. Other things it has taught us are communication and networking skills. The skills we learn in robotics aren't just useful for robotics; they help us in so many ways. They prepare us for futures in engineering and computer programming, and also in running a business and working as good team members."* The FTC Loading team members and their coaches were formally honored by the 89th Legislature of the State of South Dakota. House Commemoration No. 1042 (HC-1042) commemorated the team for showing greater interest in STEM, for winning the top place in the championship tournament in Casper, WY, and for being the first FTC team in South Dakota to be selected to compete in the super-regional competition in CA.

Red Planet Rover Design Challenge – On April 5, 2014, the Washington Pavilion in Sioux Falls, SD, affiliate Dakota State University, and SDSGC partnered in supporting the *Red Planet Rover Design Challenge* for student teams in four grade categories (K-2, 3-5, 6-8, and 9-12.) Each team must construct a rover that can navigate the terrain of a newly discovered exoplanet named "Red Planet" and complete a series of assigned tasks associated with an exploratory mission. Twenty-three (23) teams totaling 75 students have registered. SDSGC provided $250 in STEM educational supplies as prizes for the winners in the middle school category. Teams are judged in the areas of rover development and construction, presentation and journal, and demonstration and functionality.

As an interesting side note, SDSGC learned this past year that two South Dakota teachers won the **Presidential Award for Excellence in Mathematics and Science Teaching (PAEMST)**, the nation's highest honor for teachers of math and science. The PAEMST winners were: 1) Ann Anderson of Belle Fourche Middle School, winner of SDSGC's 2012 Daniel Swets Robotics Materials Award and participant in several Space Grant-funded SDDC NASA STEM workshops who also achieved SDDC's NASA SoI "Stellar Educator" status, and 2) Erin Marsh of the Pierre Indian Learning Center, who was also a participant in one of SDDC's NASA SoI training workshops during FY2013. The fact that both winners of the prestigious PAEMST award have undergone SDSGC- and NASA-funded teacher training is evidence of the quality of this training on South Dakota teachers.

Annual Performance Objective − Sponsor statewide competition for precollege STEM teacher grant. [At least one precollege teacher grant ($5,000)]
Kelly Lane Earth & Space Science Grant – This annual $5,000 grant is awarded by SDSGC to science or math teachers in South Dakota in recognition and support of

outstanding teaching and innovative educational programs at the pre-college level in the fields of STEM. Four applications were received for the FY2013 Kelly Lane Earth & Space Science Teacher Grant. The winner, selected in February 2014, was Mr. Stephan Gabriel of Spearfish High School in Spearfish, SD. His project involves environmental measurements of temperature, humidity, pressure, and ventilation direction/velocity/ volume collected by flow meters installed at 4,850 feet below ground level at SDSGC affiliate Sanford Underground Research Facility (SURF) in the old Homestake Gold Mine in Lead, SD. This impressive project implements a network of environmental sampling devices monitored in real-time by Mr. Gabriel's high school students, giving them a foothold in an active research environment where universities, doctoral candidates, and national laboratories operate. The project exposes the students to cutting edge research into dark matter, particle physics and cosmology, neutrino physics, and astrophysics through the Center for Theoretical Underground Physics (CETUP). Two of Mr. Gabriel's students have already applied to the Davis-Bahcall Scholars program, which is sponsored by 3M, SURF, and SDSGC.

Annual Performance Objective − Inspire and motivate women, underrepresented minorities, and persons with disabilities into STEM careers. [Over 1,000 females and students from underrepresented groups participate each year through Women in Science Conferences, K-12 science fairs, ACE Camp, Flandreau Indian School Success Academy, SD GEAR UP, and related programs.]

Women in Science (WIS) Conferences in FY2013 – Through its partnership with the SD Discovery Center (SDDC), SDSGC partnered with local businesses and continued to support six highly successful Women in Science (WIS) conferences held throughout the state during FY2013 in Pierre, Sioux Falls, Watertown, Rapid City, Aberdeen, and Yankton, SD. Each conference is organized with volunteers strongly committed to inspiring middle and high school girls to continue with courses in math and science and to consider STEM careers. The March 11, 2014, Rapid City WIS conference held at SDSM&T doubled their attendance from the previous year; 650 girls attended the 2014 conference. Professional women gave half-hour presentations on STEM careers and many of the girls participated in a planetarium show that featured women from NASA and an overview of their work. Collectively, the six FY2013 WIS conferences reached 2,234 middle and high school girls, an increase of 217 girls over FY2012. Of the 2,234 girls, 21% are minority (11% Native American; 10% other minorities). Additionally, 250 teachers, parents and volunteers participated in the events. Of the 2,234 girls, roughly 90% were in middle school and 10% in high school. NASA activities and programs were at the forefront of many of the FY2013 conferences. For example, SDDC, home of South Dakota's NASA Summer of Innovation (SoI) program, conducted planetarium programs, promoted *Women@NASA.com*, and shared NASA and SoI recruitment materials during the Watertown and Rapid City WIS conferences. Also in FY2013, at the Aberdeen WIS conference, which has offered WIS conferences for over 10 years, two of their past students come back to the conference as speakers. One of those two past WIS conference students became a teacher and brought her students to the 2013 conference. The conferences featured many NASA and Space Grant-related presenters, exhibits, and activities. These include USGS EROS Data Center staff, Aviation Camp and SDSM&T SoI Camp exhibits, physics activities from SURF, student

displays of their FLL robotics activities, and SDDC planetarium programs featuring Women@NASA. The Rapid City WIS conference organizers received their own 501c3 designation this past year, indicating an improved move in the area of sustainability in funding. Another interesting first for WIS conferences during FY2013 is that the Pierre WIS Conference Coordinating Committee is actually led by three female students who organized the conference and secured the keynote speaker and other presenters.

Summer 2013 STEM Youth Camps and Courses – As part of the partnership with aerospace company L-3 Communications West (Salt Lake City) wherein SDSGC provides $12,000 for two SDSM&T graduate student scholarships in robotics in return for L-3 hiring four to five SDSM&T student interns during the summer, SDSM&T also provided $2,250 in Space Grant scholarship support for five middle and high school students (four of whom were girls) to participate in two, week-long summer 2013 STEM camps titled: *"Power Camp: Electronics and Computers in Your Hands"* and *"Robotics Camp."* Similarly, SDSGC provided $2,000 to support ten (10) precollege students that participated in the fall 2013 HIGHER STEPS program at SDSM&T. HIGHER STEPS is a seven-week program designed and taught on Saturday's by faculty in SDSM&T's Electrical and Computer Engineering Department. During the fall 2013 semester, the ten high school students came to campus to conduct hands-on activities in robotics and radios where they learned about soldering, programming, and other aspects involved with pursuing a degree in Electrical and Computer Engineering.

Annual Performance Objective − Increase teacher capacity to effectively incorporate aerospace and earth science into the curriculum. [At least 100 teachers will participate in workshops facilitated by SDSGC such as NASA AESP training, GIS/GPS training, E-missions, GEMS, and StarLab/Digitarium/Uniview Planetarium astronomy training.]
As part of SDDC's annual Space Grant subaward, $3,600 is used to support two pre-service education majors as summer science educator interns at SDDC. Through the internships, these two pre-service teachers receive extensive mentoring, training and practice in the use of NASA Summer of Innovation and other STEM materials plus Great Explorations in Math and Science (GEMS) curriculum training. During summer 2013, they used this training to provide space and other STEM camps/workshops to about 500 pre-school through 8th grade youth. The SDSGC internship funding was matched by $3,950 from the SD Governor's Office of Economic Development "Dakota SEEDS" program and other non-federal SDDC funds.

Annual Performance Objective − Support programs that expose K-12 students to hands-on experiences and to educational and career opportunities in the fields of aerospace, earth science and technology.
During FY2013, affiliate SD Discovery Center (SDDC) provided 94 StarLab Planetarium programs to 2,350 precollege students and 629 adults (teachers and parents.)

In addition to the precollege programs and student/teacher participant numbers highlighted above, SDSGC headquarters staff provided an additional 9 precollege NASA STEM programs at schools and museums during FY2013 reaching 471 students and 59 teachers as direct participants. Of the students, 63 were elementary (13%), 330 middle

school (70%), and 78 high school (17%). Of the total number of 471 students reached by headquarters staff presentations during FY2013, 37% are Native American.

Annual Performance Objective − Facilitate partnerships for grant applications that aim to strengthen precollege STEM education. [Annually, SDSGC affiliates will participate in at least one precollege education proposal.]
SDSGC affiliates Journey Museum and SDDC teamed up to respond to NASA's 2013 "Competitive Program for Science Museums, Planetariums and NASA Visitor Centers Plus Other Opportunities+" (CP4SMP+) solicitation and submitted a four-year $1.2M proposal titled *"Journey Into Space: Discoveries in STEM."* In December 2013, SDSGC learned that the proposal was declined for funding.

NASA Education Outcome 3 Accomplishments
Informal Education Programs (Public Service)
Annual Performance Objective – Partner with informal education affiliates to disseminate NASA content, share NASA educational resources, and host major NASA science education events. [15 informal education providers and 500 students share NASA resources; 150 teachers and 2,200 students participate in NASA science education events such as SD Space Days]
South Dakota Space Days 2013 at Badlands Astronomy Festival was held for the second year in a row at Badlands National Park on August 2 - 4, 2013. The three-day event consisted of presentations, star parties, rocket launching, planetarium show, build-your-own-sundial workshops, and Minuteman Missile programs. 996 people attended various components of the event over the three-day period. SDSGC's lead institution **SDSM&T** and the following Consortium affiliates assisted Badlands National Park in sponsoring the event by supplying staff and resources such as telescopes and portable planetariums for numerous presentations over the three days: **Journey Museum, Black Hills Astronomical Society**, and **SD Discovery Center**. South Dakota Space Days is an annual public service event held at different locations throughout the state. It typically draws thousands of students and teachers from throughout the state who then participate in "hands-on" STEM educational activities. Students visit with experts in aerospace, aeronautics, earth science, engineering, computer science, physics, and other STEM fields about their careers. Guest speakers with nationally recognized credentials such as NASA astronauts, scientists, and managers present programs and meet with the public. Numerous exhibits on space and earth science and technology are provided each year by members of SDSGC and other organizations.

SDSGC headquarters staff provided an additional four NASA space-related informal education programs to 90 members of the general public during FY2013. Presentations were given at: A) the Black Hills Chapter, South Dakota Engineering Society's January 21, 2014, meeting in Rapid City, SD; B) Primrose Senior Living Center on Feb. 26, 2014, in Rapid City, SD; and C) the Journey Museum's "Super Saturdays" public events on March 15 and 22, 2014. Additionally, SDSGC Deputy Director was interviewed on SD Public Radio's *"Dakota Midday"* program on July 29, 2013, on the subject of the 55th anniversary of President Dwight Eisenhower's signing of the National Aeronautics and Space Act, the legislation that created NASA.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Student Data and Longitudinal Tracking:**
  Total NASA Fellowship/Scholarship awards under SDSGC's FY2013 base grant = 38; 10 of the total awards were made to underrepresented minority students. During the FY13 program year, a separate suite of 38 students who were significantly supported from FY2006-FY2013 funds took their next step; 11 students are pursuing advanced degrees in STEM disciplines, 3 accepted STEM positions at NASA contractors, 19 accepted STEM positions in industry, 1 accepted a STEM position in K-12 academia, and 4 accepted STEM positions in academia. The remaining students have not yet received the degree that they were pursuing while the received their Space Grant award.

- **Minority-Serving Institutions: $480,000 Space Grant Innovative Pilot in STEM Education Project Funded during FY2013 -** In last year's (FY2012) APD report, SDSGC reported that affiliate SD Discovery Center responded to NASA's 2012 "Space Grant Innovative Pilot in STEM Education" CAN by submitting a two-year $480,261 precollege, pre-service teacher-training proposal titled *"Rising Star Educator Program."* In August 2013, SD Discovery Center was selected for that award. The *Rising Star Educator Program* is comprised of three primary partners: South Dakota Discovery Center, Sinte Gleska University (a Minority-Serving Institution and Tribal College affiliate of SDSGC), and SDSGC. The program is focused on developing a model to increase the number of educators who can effectively teach NASA-focused STEM in schools on American Indian reservations in South Dakota. In a cohort model, junior and senior education students at Sinte Gleska University (SGU) receive the multi-faceted support necessary to become effective STEM educators. STEM education experts, mentors, community education supporters, and STEM professionals work together to provide these Tribal College education students with: A) NASA-rich STEM content knowledge and pedagogy, B) field experiences working with STEM professionals, C) opportunities to teach in NASA Summer of Innovation summer camps, and D) access to STEM resources. Each aspect of the program is embedded with culturally relevant learning experiences. Students enrolled in Sinte Gleska University's Education Program (predominantly female in the age range of 25-49) represent a dedicated group of people committed to providing a high quality education for the children of the Rosebud Indian Reservation. The majority are first generation college students that are employed in the area's public and tribal schools as well as in the Head Start program. Sinte Gleska University students face many challenges and barriers in the pursuit of their educational goals. They often struggle to provide for their families, and in some cases extended families, while residing in one of the poorest counties in the nation. The costs of attending college, including day care, transportation, and other related expenditures, create an extreme burden for these students in pre-service education. The SGU Teacher Education Program is primarily K-8 elementary education with a middle school endorsement. Although there is not a STEM major in secondary education, many pre-service teachers take STEM courses in preparation for

the science or math Praxis test. Upon passing, they can then teach science or math. Both elementary and secondary education students participate in the *Rising Star Educator Program*. For at least five years prior to being selected for the $480,281 Space Grant Innovative Pilot in STEM Education award in 2013, SDSGC had been supporting this type of NASA STEM pre-service teacher training through its subaward to the SD Discovery Center, albeit at a much smaller level. In a general sense, this shows how the persistent use of Space Grant seed funding can be successful at winning larger NASA grants for meritorious NASA/STEM teacher-training programs.

- **NASA Education Priority Accomplishments:**
  - **Hands-on student experiences in NASA-related STEM disciplines** that incorporate real-life problem-solving needs were provided to the following five multi-disciplinary university student teams at SDSM&T, most of which participated in national competitions during FY2013 with Space Grant support, several of which are summarized above under Outcome 1 Higher Education: 1) Hybrid Sounding Rocket Team, 2) Robotics Team, 3) *Moonrockers* Lunabotics lunar regolith excavator team, 4) Unmanned Aerial Vehicle Team, and 5) Autonomous Underwater Vehicle Team. Similarly, authentic experiences were provided to precollege students through significant direct support from Space Grant as detailed elsewhere in this report, including: 1) students from 40 middle school SD FIRST LEGO® League (SD FLL) teams who benefited from participating in the 5th Annual SD FLL Robotics Tournament in January 2014, 2) 2,234 middle and high school girls who attended six Women in Science Conferences in South Dakota during FY2013, 3) 23 high school student participants of SDSU's 2013 Aerospace in Engineering (ACE) Camp, and 4) 280 reservation high school students (85% Native American) who attended the six-week, residential college-preparatory summer 2013 GEAR UP program at SDSM&T.

    Five (5) South Dakota students conducted hands-on, STEM-focused internships/co-ops at NASA Centers during FY2013; two of which (internships at KSC and Johns Hopkins University Applied Physics Lab) were funded by Space Grant and three (two internships at JSC and one co-op at JSC) were funded by NASA Centers. One example follows.

    Jesse Hinricher, a Chemical Engineering and Chemistry major at SDSM&T, was provided a Space Grant stipend of $10,700 to conduct a 16-week spring 2014 semester internship at **NASA Kennedy Space Center**. Jesse's internship project involves NASA's Lunar Advanced Volatile Analysis (LAVA) subsystem of the Regolith and Environment Science and Oxygen and Lunar Volatiles Extraction (RESOLVE) system. NASA plans to place the RESOLVE system on a lunar or Mars rover to look for resources that could be used for fuel or to create breathable air for astronauts on future space missions. Prior to leaving for KSC in January 2014, Hinricher said: *"I have always been fascinated with space, and NASA has always appealed to me. I*

grew up being a fan of Star Wars and when I found out that I could apply for an internship with NASA, I jumped on the chance. This internship will allow me the opportunity to contribute to the space program and gain valuable research experience. … Don't pinch me because I'm not sure if it's real and I don't want to wake up. It was really great. I had to listen to the voicemail I bet a half a dozen times before it finally registered what was going on."

- **Diversity of institutions, faculty, and student participants** – Two of SGSGC's ten Higher Education affiliates are Tribal Colleges and Universities (TCU's.) For Outcome 1 higher education programs, 26% percent of the FY2013 base grant fellowship/scholarship awards went to minority students (far exceeding SDSGC's goal of 10%) and ~40% went to females (45% in terms of the total dollar amount, which exceeded the targeted goal of 40% of awards to females).

Diversity Summit – On Feb. 6-7, 2014, a Diversity Summit organized by the SD EPSCoR program was held in Rapid City, SD. The SD Board of Regent's (SD BoR) Office of STEM Education is a State affiliate of the SDSGC. SD BoR affiliate representative Phil Huebner was a key organizer of the summit. He arranged for SDSGC Director Dr. Ed Duke to speak about the diversity goals of the SDSGC and its opportunities for students. The theme of the Diversity Summit was *"The 2020 Vision: Engaging Talent Across South Dakota."* The event provided an opportunity for the 75 students, faculty, and private sector employers who attended to gain a greater understanding of the challenges and opportunities that underrepresented students face in pursuing STEM careers in South Dakota. Presentations were made by representatives of academia (State and Tribal), industry, and State government. Keynote speaker Dr. George Blue Spruce of Phoenix, AZ (retired Assistant Surgeon General of the U.S.), spoke about his life, struggles, accomplishments, and inspirational messages on how individuals can achieve their dreams.

During FY2012, SDSGC established a $1,000 Space Grant student scholarship in match of the **Herrington Crazy Horse Scholarship** (named for Native American Astronaut Commander John Herrington) for a Native American student attending SDSM&T. Cmdr. Herrington, with his own personal funds, established this $950 scholarship at SDSM&T in support of a Native American who is in the Tiospaye Scholars Program. The FY2013 winner of the Herrington Crazy Horse Scholarship was Jeremy Adams, a Native American sophomore in Mechanical Engineering at SDSM&T; and the Space Grant matching award recipient for FY2013 was Vaughn Vargas a Native American sophomore in Industrial Engineering.

- **Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise** – Through annual SD Space Grant funding, the SD Discovery Center (SDDC) continued their training relationships with several organization across the

state, thereby helping to institutionalize NASA and STEM resources as part of the curriculum in these locations/organizations. In FY2013, the following organizations participated in the training: A) Sinte Gleska University pre-service teachers, B) educators from 21st Century Community Learning Centers serving Title I schools, and C) teachers attending the February 2014, SD science and math teachers' conference in Huron, SD. SDDC is piloting a new system for delivering STEM professional development to rural educators. Using the state's Dakota Digital Network, monthly "STEM Quick Stops" consist of two-hour workshops delivered via distance technology. This has been effective in reaching a new audience of educators. All who participate are eligible to earn college credit through a combination of workshop time and use of the materials with students. The STEM Quick Stops have been such a success that SDDC will continue this method of professional development for another year. Interestingly, one of the STEM Quick Stop participants (a teacher) took a workshop that the SDDC Executive Director (and SDSGC Associate Director) co-taught with educators from NASA's Challenger Learning Center many years ago called E-missions. SDSGC's Associate Director at SDDC hadn't heard from this teacher for years until she signed up for a Space Grant-funded class in the fall of 2013 called "GEMS in Action – Implementation." The teacher indicated that she still faithfully conducts E-missions with her students each year. She noted that much of the science that she teaches is from SDSGC-funded educational guides that she has received from SDDC conferences and workshops over the years. Her school does not even purchase science texts anymore because they want the teachers to predominantly teach math and reading. This teacher has continued to participate in the STEM Quick Stops and has recruited five other teachers from her school district who now also participate in the monthly workshops. This is an example of how SDSGC funding makes a long-term difference in the way (and in the amount) of STEM that is taught in certain schools in South Dakota.

- **Summer 2013 opportunities for secondary students on college campuses** with the objective of increased enrollment in STEM disciplines and interest in STEM careers included the following camps supported by Space Grant: 1) the 22nd annual, week-long **2013 Aerospace Career and Education (ACE) Camp** held on the campus of SDSU with 23 high school students (as described earlier under "Program/Project Benefit to Outcome Education - Education Outcome 2"), and 2) the six-week **2013 South Dakota GEAR-UP** residential college preparatory program held on the campus of SDSM&T with 280 high school students from 24 Tribal schools, described below.

  South Dakota GEAR UP Honors 2013 Program – The 2013 SD GEAR UP (Gaining Early Awareness and Readiness for Undergraduate Programs) Honors Program was held on the SDSM&T campus from June 1 – July 12, 2013, for the 21st consecutive summer with a contingency of 280 high school students from grades 9-12 (85% of whom are Native American and 60% of

whom are female) and 40 staff members. The purpose of the six-week residential, STEM-focused, college preparatory honors program is to prepare American Indian students to be successful in the college setting. Much of the program funding comes from a federal GEAR UP grant through the State of South Dakota Department of Education. The program is operated through the Oceti Sakowin Education Consortium and 24 tribal schools within South Dakota. Most of the students in 2013 were first-generation college students. Students who attend GEAR UP must apply as 8th graders to enter the program and are selected based on academic achievement and teacher recommendations. Students represent all nine tribes in South Dakota: Cheyenne River, Crow Creek, Flandreau-Santee, Lower Brule, Oglala, Rosebud, Sisseton-Wahpeton Oyate, Standing Rock, and Yankton. A middle school component allowed several 6th-8th graders, along with their parents, to visit SDSM&T for a few days at the start of the six-week program to tour campus and learn about the academic programs available. The curriculum includes Math (Algebra, Trigonometry, Pre-Calculus, and College Algebra), Science (Physical Science, Biology, Chemistry, and Physics, including laboratories), English, Computers, and Life Skills (goal setting, leadership, study skills, personal finance, and college preparation). The curriculum is further enriched with field trips, recreation and sports, college visitation, and cultural activities. Of those students who graduate from the GEAR UP program, virtually 100% also graduate from high school, 85% attend college, and 7% enter the military. SDSM&T faculty, staff, researchers, and administrators offer daily seminars to present topics on career exploration and professional development. Mini-courses and hands-on activities are offered in a wide variety of topics. Tours are provided in the many labs across the campus. SDSGC again supported the program by providing NASA-STEM curriculum and presentations about space for student participants.

With SDSGC support, SDSU's annual **Girls: Engineering, Mathematics and Science (GEMS)** one-day workshop for 8th grade girls was held on the campus of SDSU on March 2014, and provided 44 girls and 15 parents and teachers with an opportunity to explore interests in engineering, science and technology. Similarly, SDSU's Space Grant-supported **Ready SET (Science, Engineering & Technology) Go!** camp is a one-day, annual workshop for high school girls held in November 2013, on the SDSU campus, with 40 girls and 16 parents and teachers. It is modeled after the 8th grade GEMS camp with activities more suited to high school age students.

After ten years of SDSGC support for the **SDSU-Flandreau Indian School (FIS) Success Academy**, the program unfortunately had to be discontinued during FY2013 due to funding limitations experienced by some of the other organizations that helped to fund the Success Academy. However, a book titled *Success Academy: How Native American Students Prepare for College (and How Colleges Can Prepare for Them)* by MaryJo Benton Lee was published in September 2013, by Peter Lang Publishing, Inc. (ISBN-13:

9781433119453). One of the chapters addresses SDSGC's important role in making possible the students' senior year in the Academy. FIS Success Academy was an early, intensive college preparatory program for Native Americans, serving about 250 FIS students in grades 9-12 each year.

- **Community Colleges** – SDSGC has one technical institute affiliate that meets the criteria for NASA's upcoming 2014 *Competitive Targeted Community College and Technical Schools* solicitation; Lake Area Technical Institute (LATI) in Watertown, SD. LATI offers Associate of Applied Science degrees and has programs in aviation maintenance and robotics. In 2013, LATI made the number 4 spot on the Aspen Institute's list of 150 community colleges within the U.S. that are eligible for the Aspen Prize for Community College Excellence. This designation shows that LATI has demonstrated strong outcomes in three areas of student success: A) student success in persistence, completion, and transfer; B) consistent improvement in outcomes over time; and C) equity in outcomes for students of all racial/ethnic and socioeconomic backgrounds. SDSGC worked with LATI during FY2013 on plans to submit a proposal under NASA's 2014 *Competitive Targeted Community College and Technical Schools* solicitation. The project currently envisioned would allow for the addition of Unmanned Aerial Systems into the curriculum for LATI's aviation maintenance and operations program.

- **Aeronautics research** – Space Grant student fellow at SDSM&T Tony Kulesa and his faculty advisor Marc Robinson presented their NASA-funded research *"Analytical study of thermal and mechanical properties of syntactic foams for space applications"* at the 64th International Astronautical Congress, Sept. 23-27, 2013, in Beijing, China.

- **Environmental Science and Global Climate Change** – One of the six FY2013 Project Innovation Grants listed under the Higher Education section of this report is SDSM&T's *"Green Chemistry Education Workshop for Middle School Teachers in the Rapid City Area"* funded by SDSGC for $12,000. This three-day workshop program introduces concepts of green chemistry to middle school science teachers and gives them opportunities to think about the field of chemistry from a new perspective. Challenges and opportunities in green chemistry education are addressed, and green lecture materials and hands-on experiments are presented for them to use in their classrooms. By introducing green chemistry concepts, teachers will be able to stimulate their students' creative thinking and curiosity. The students will be able to recognize a current scientific environmental problem and consider alternative solutions. An example of one of the sessions is lithium ion batteries for electric/hybrid vehicles and how implementation of that technology relates to the issue of global climate change. Other sessions address renewable sources of energy and types of renewable energy such as alternative biofuels; their environmental benefits and their impacts on jobs, the economy, and energy security. The workshop better prepares these middle school teachers to educate

their students about environmental issues pertaining to the chemical industry. It is designed to provide an understanding that workers involved within the chemical industry are cognizant of global problems facing their industry from an environmental standpoint. The workshop will be offered for one college credit hour.

- **Support of innovative research infrastructure activities to enable early career faculty to focus research toward NASA priorities** – The following two of the six FY2013 Project Innovation "seed" Grants listed under the Higher Education section of this report provide early career faculty support for NASA-focused education and research: A) Dakota State University's *"STEM Institute: An interdisciplinary program for maximizing student recruitment and retention in STEM majors at DSU"* funded by SDSGC for $10,000, and B) SDSM&T's *"Mines Experimental Rocketry"* funded for $5,000.

IMPROVEMENTS MADE IN THE PAST YEAR

Management Team Retreat – The nine members of the SDSGC Management Team gathered for a first-ever retreat on November 6-7, 2013, to discuss the future direction of the Consortium in terms of: A) the desired focus, B) SDSGC's values to South Dakota and NASA, C) program accomplishments, D) what has worked well and what would we change, E) the feedback from our 2013 in-house affiliate survey, F) how we can improve Consortium programs and management, and G) tighter budgets for the past two years and expected continuation of the reduced budget. This "retreat-style" meeting was very-well received by the management since it provided a venue to think beyond the normal tight agendas that we have at routine quarterly Management Team meetings and monthly teleconferences.

NASA Educational Opportunities Distribution System (NEODS) – During a retreat of SDSGC's Management Team in November 2013, a $5,000 one-year Space Grant-funded pilot project titled "NASA Educational Opportunities Distribution System" (NEODS) and administered through SDDC's Space Grant subaward was approved on a trial basis. SDDC's NASA Summer of Innovation project co-coordinator was selected to lead this project. The pilot runs from Jan. 2014 – August 2014 and includes:

- An efficient system for distributing NASA-STEM educational opportunities to teachers and educators in an effective, grade-appropriate manner, working with the SD Dept. of Education in developing various targeted listservs.
- Testing ways to best secure an active audience for the distribution.
- Sending out weekly briefs to the educator groups that highlight timely NASA/Space Grant opportunities without having those groups have to dig through NASA's extensive education websites and releases.
- Working with the SDSGC evaluator to design an evaluation system.
- Providing a report and recommendations to the SDSGC Management Team about the effectiveness of the project and best practices.

Other Improvements in FY2013:

- In November 2013, SDSGC's Management Team revised the consortium's Strategic Plan to bring it up to date with current NASA education priorities.
- SDSGC was successful in doubling the amount of fellowship/scholarship applications from students from affiliate Oglala Lakota College, a Minority-Serving Institution, in FY2013 (12 applications; 6 funded) compared to FY2012 (6 applications; 4 funded.)
- In July 2013, SDSGC formally affiliated with the South Dakota Board of Regents (SD BoR) "Office of STEM Partnerships" in an effort to strengthen our alignment with precollege STEM education efforts within the state that are supported by the SD BoR. Thus, our affiliation with SD BoR now includes both the Office of STEM Partnerships and our previous collaboration with SD BoR's Office of Research and Economic Development, whose Vice President has sat on the Consortium's Management Team as an ex-officio member for the past several years.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

SDSGC is a statewide network of 19 organizations from education, industry and government. The Consortium's eight-member Management Team consists of representatives of a cross section of the membership including SD School of Mines & Technology (the Lead organization), SD State University, Augustana College, University of South Dakota, USGS Earth Resources Observation and Science (EROS) Center, South Dakota Discovery Center, the Journey Museum, and an ex-officio member who is Vice President of Research for the South Dakota Board of Regents. The full membership consists of the following list of educational, industrial, and government affiliates including the type of institution and the affiliate's role in SDSGC project execution.

Educational Affiliates

- South Dakota School of Mines and Technology (Lead Institution, state university BS-PhD, science and engineering; administration of Consortium's involvement in all Outcome 1, 2 and 3 programs)
- South Dakota State University (state university BS-PhD, agricultural and STEM institution; management in Outcome 1 higher education/research and Outcome 2 precollege robotics and other STEM programs)
- Augustana College (four-year private liberal arts and professional college; management in Outcome 1 higher education/research and Outcome 2 precollege robotics and other STEM programs)
- University of South Dakota (state university BS-PhD, medicine, law, fine arts, business; management in Outcome 1 higher education/research programs)
- Black Hills State University and Center for the Advancement of Mathematics and Science Education (four-year, state liberal arts institution; Outcome 2 pre-service education)
- Dakota State University (state university, Associates-PhD, computer management; limited involvement in Outcome 2 higher education)

- Northern State University (state university, BS-MS, business, education, arts and science; new affiliate with anticipated involvement in Outcome 2 higher education)
- Oglala Lakota College (Tribal College, AA-MS with STEM majors; Outcome 1 higher education/research)
- Sinte Gleska University (Tribal College, four-year institution; Outcome 1 higher education/research and Outcome 2 precollege STEM programs)
- Lake Area Technical Institute (technical institute, Associate of Applied Science degrees, robotics and aviation maintenance; Outcome 1 higher education)
- South Dakota Discovery Center and Aquarium (science center; management in Outcome 2 teacher-training and precollege robotics and other STEM programs including management of 2011 Summer of Innovation Grant)
- The Journey Museum (museum; management in Outcome 2 precollege planetarium, robotics, and other STEM programs and Outcome 3 public service astronomy and earth system science programs)
- Badlands Observatory (private observatory, astronomical research/education; Outcome 1 higher education and astronomical research)
- Black Hills Astronomical Society (astronomical society; Outcome 3 public service astronomy programs)

State and Federal Government Affiliates

- Sanford Underground Research Facility at Homestake (a state organization under the management of the SD Science & Technology Authority; Outcome 1 physics research and higher education internships, Outcome 2 precollege STEM programs)
- USGS Earth Resources Observation and Science (EROS) Center (data management, systems development, and research field center; Land Processes Distributed Active Archive Center for NASA's Earth Observing System; operation of new Landsat 8 mission; management of Outcome 1 higher education and research programs in remote sensing)
- South Dakota Board of Regents (BoR) – The following BoR offices: A) Office of Research and Economic Development, and B) Office of STEM Partnerships

Industrial Affiliates

- Raven Industries (engineered films, high-altitude balloons, GPS products; NASA contractor and partner in SD NASA EPSCoR research project; Outcome 1 research and development in aerospace, higher education student internships)
- RESPEC (consulting & services: engineering, IT, water & natural resources; Outcome 1 research in remote sensing and higher education student internships)

* L-3 Communications West, Salt Lake City, UT – a non-affiliate industry sponsor of SDSGC (aerospace, communications, and electronic systems government contractor; Outcome 1 research and development, and higher education student internships)

The National Space Grant Office requires two annual reports, the Annual Performance Data Report (APD) and the Office of Education Performance Measurement System (OEPM) report. The former is primarily narrative and the latter data intensive. Because the reporting timeline cycles are different, data in the two reports may not necessarily agree at the time of report submission. OEPM data are used for official reporting.